



THE AID NOW GRANTED BY THE STATE
TOWARDS THE INSTRUCTION OF
THE INDUSTRIAL CLASSES
IN ELEMENTARY
SCIENCE :
ITS NATURE AND RESULTS.

BY J. F. D. DONNELLY, CAPT. R.E.,
Inspector for Science of the Science and Art Department.

1861.

THE AND NOW GRANTED BY THE STATE
TOWARDS THE INSTRUCTION OF
THE INDUSTRIAL CLASSES
IN ELEMENTARY
SCIENCE
ITS NATURE AND RESULTS

BY J. E. D. DORRIS, CANT. R.E.
Inspector for Science of the Science and Art Department

1881

*THE AID NOW GRANTED BY THE STATE
TOWARDS THE INSTRUCTION OF THE
INDUSTRIAL CLASSES IN ELEMENTARY
SCIENCE: ITS NATURE & RESULTS.*

It may be interesting to some here to be made acquainted with the nature and amount of assistance granted by the State towards the instruction of the industrial classes in Elementary Science, and the success of the system as far as it has been tried. I have therefore prepared a general outline of the system and of its ascertained results.

This aid is given through the Science and Art Department which as you may be aware is now one division—the Education Department being the other—of the Committee of Council on Education, under the ministerial control of the Lord President of the Council and Vice President of the Committee of Council on Education for the time being.

The Science and Art Department was constituted in 1853 by a consolidation into one department under the Board of Trade of the Department of Practical Art, the Royal Dublin Society, the School of Mines and Geological Survey, the Museum of Irish Industry, the Industrial Museum of Scotland, and the Committee of Lectures in Dublin. In 1857 the Department with the Navigation and a few Science Schools which had been added to it, was transferred to the Committee of Council on Education, and was, as the minute states, to offer increased means for the promotion of secondary or adult instruction while the Education Department at Whitehall continued charged with primary Education.

The first attempt to establish provincial Schools of Science was made in 1853, but with the exception of a few experimental attempts principally as Trade and Mining Schools there was scarcely anything done in this direction, till 1859, when, under the Marquess of Salisbury as President, the whole subject was reconsidered and the first general Science Minute passed. This Minute forms the basis of the present system, and with the several modifications which have been introduced into it from time to time is embodied in the "Science Directory" published by the Science and Art Department.

The subjects, towards instruction in which aid is given by the Department, are—

1. Geometrical Drawing, including Practical Plane and Descriptive Geometry, Mechanical and Machine Drawing, and Building Construction.
2. Mechanical Physics.
3. Experimental Physics.
4. Chemistry.
5. Geology and Mineralogy.
6. Animal Physiology and Zoology.
7. Vegetable Physiology, Economic and Systematic Botany.

Each of these forms a distinct *subject* in the language of the Directory, but for the convenience of the Teachers and Pupils they are each divided into two subdivisions, except the first which is divided into three.

And besides these, for the Navigation Schools specially, there are Mathematics, Navigation and Nautical Astronomy, and Physical Geography. The Navigation Schools have necessarily certain peculiarities, but as they are not of such wide application and as their system may be understood generally from that of the Science Schools I need not refer to them further but will confine myself to the Science Schools and Classes proper.

Before proceeding to describe in detail the manner in which aid is given I may state generally that the principle on which all the regulations are based is not to assist directly by aiding *in* the accomplishment, but indirectly by rewarding *for* the accomplishment of the desired result, that is by paying for results only.

The principle of paying on results is carried very nearly, but not quite, to its utmost limits. The purest system of payment on results would of course be to pay a certain sum for every artisan who had received a certain amount of instruction in Science to be tested by an examination, disregarding wholly the conditions under which he had been taught. This for various reasons is not done. The only teachers, towards the instruction or for the instruction of whose pupils, the Department pays are those who have been certificated as competent to teach any of the before-mentioned Sciences. And by a peculiar system of paying on results which I shall explain, the Department rewards the teacher for the number and grade of his certificates.

The Department holds, in November of each year, an examination of all persons who choose to come up and try for

certificates either in one or more of the subjects, or in a subdivision of a subject only.

These certificates are of three grades, 1st, 2nd, and 3rd class, each certificate entitling the owner to earn, under the head of certificate allowances, 20*l.*, 15*l.*, or 10*l.*, according to its grade, that is, if the certificate is for a whole subject, and *half* that amount if in a subdivision only.

To test and pay the teacher on the results of his teaching, the Department holds in May in each year examinations in the various sciences at all places in the kingdom, where there are classes presenting themselves for examination, and complying with certain conditions. Then for every pupil of the artizan class who *passes* such an examination as will justify the examiner in reporting that his instruction has been sound, and that he has benefitted by it, the teacher receives 4*l.* of his certificate allowance. I may say that the artizan class is broadly defined, as including all who are in the receipt of weekly wages, and their children. In the case of others who, receiving payments at longer intervals than a week, may still from the smallness of their income be justly entitled to the same benefits, a special application has to be made by the Committee of the School or class, and is considered on its merits.

The pupil, on account of whom payment is claimed, must have received 40 lessons at least from the teacher, not necessarily all in one year, but since the last examination at which payments were claimed on his account. The examinations are held simultaneously all over the Kingdom and are distinct in each subdivision of the subjects which I mentioned before, that is each subdivision is taken separately.

Taking the case of M.N.—and I may say this is not a fictitious case but the account of one of the teachers at the late examination, which I have taken as an example,—he is qualified to earn 51*l.* 10*s.* having a first grade certificate in Chemistry, a first grade certificate in one subdivision of Experimental Physics and a certificate of the Education Department which by the rules he is allowed to count. M.N., had a class in Chemistry and another in Physics, they were examined last May: 22 of his pupils passed and he received the whole of his certificate allowance, 51*l.* 10*s.*; if 15 only had passed he would have received the same, that is, at the rate of 4*l.* per passed pupil up to the amount he was qualified to earn by his certificates; for the amount that he may receive

under the head of certificate allowance is limited by the value of his certificates ; however, many of his pupils pass, M.N., could not receive more than 5*l.* 10*s.* under the head of certificate allowance. But this is not the only way in which he earned payments. This condition, easy of fulfilment, is the means I spoke of to reward the teacher for his attainments, to induce him to work for and obtain certificates of the highest grade, by making a portion of his reward depend on his personal acquirements as distinct from his success in teaching ; whilst there is another condition not so easy of fulfilment by which he may earn amounts only limited by his success in teaching. In fact the amount he may earn altogether by successful teaching is not limited by his certificate allowance or in any way by the rules.

For every one of his pupils of the artizan class who took a Queen's prize, that is, shewed a knowledge something above the mere *pass*, M.N. received 3*l.*, 2*l.*, or 1*l.*, according to the grade of the prize, over and above anything he received under the head of certificate allowance. In this way he received 10*l.* ; or we may take an extreme case, and supposing M.N. had not been able to collect a large class, but had taught one artizan very well, that he was examined, and took a first class Queen's prize, M.N. would receive 7*l.*, 4*l.* of his certificate allowance, and 3*l.* payment on Queen's prize.

These illustrations will I hope make this portion of the rules clear. The amount that a teacher may earn under the head of certificate allowance is restricted, but there is no restriction as to the whole amount which he may by ability and hard work obtain.

To refer now to the Queen's prizes and rewards to students.

There is no restriction as to the class of persons who may obtain them, it being an object to induce the richer classes to learn and pay remunerative fees to the teacher, which it is assumed, that at present the poorer classes will not. Any one may come up to the examinations, not merely those who have been receiving instruction from the certificated teacher, but outsiders of every class. Indeed, it is made a condition that the committee of a Science school or class shall provide a room for the examination of every one who wishes to be examined ; charging, if they think fit, a small fee not exceeding 2*s.* 6*d.*, to reimburse them in any extra expenses. And further, the Department examination is open to any other classes though

not taught by a certificated teacher, on certain conditions being complied with.

At these examinations all candidates who pass a creditable examination receive, according to their merits, Queen's prizes of the 1st, 2nd, or 3rd class, consisting of books of different values, according to the grade of the prize. These prizes are not given in competition, but depend, like the certificate of teachers, on certain standards of proficiency being attained. And, as I before stated, for all Queen's prizes taken by artisans taught by the certificated teacher, the certificated teacher receives 3*l.*, 2*l.*, or 1*l.*, as the case may be. He receives no payments for prizes taken by other pupils, nor does an uncertificated teacher receive payments for any pupils of his of the artisan class who take prizes: but the prizes themselves are open to all.

The only other condition towards obtaining the aid of the Department is that the school or class taught by a certificated teacher, and on which he claims payment, must be open at any time to the visit and inspection of the officers of the Department, that they may see that there is a proper room, etc., provided for the instruction of the class, and that the apparatus, diagrams, etc., towards the purchase of which the Department at present allows 50 per cent. is kept in proper order. Besides the Queen's prizes there are in each subject six medals offered for competition among all the classes. The medals are one gold, two silver, and three bronze, in each subject, and are given to the most successful candidates if their attainments are such as to justify the examiners in recommending them.

As the examinations in each subject are held simultaneously all over the Kingdom, it is necessary to call in local agencies to give their assistance, for it is evident the Department cannot furnish officers to conduct or superintend examinations in fifty or perhaps a hundred different places on one night. The committees of the schools are entrusted with this duty. The examination papers prepared in London by the examiners are forwarded to them, they superintend their working, and return the worked papers to the Department for revision, three at least of the Committee certifying to their having been present and seen them fairly worked.

A great saving is thus effected in the machinery of inspection and examination, and an attempt made, by decentralizing the system, and calling on local exertion for assistance, and trusting to it, to create and keep alive an interest in the subject. The

one examination provides the tests for passing for Queen's prizes, and for Queen's medals.

The Department calls on the Committee also for further assistance. As soon as the results of the examination are made known, the certificated teacher fills up a form of application for salary, with the names of the successful pupils on whom he claims payment. The Committee then certify to the claim on the two points of the teacher having given 40 lessons at least, and of their being artisans or operatives, or their children. As soon as these lists are verified, the teacher receives his payments, that is once a year.

The applicability of such a system as this could only be shewn by experience. For it is dependent on the fact of there being means in the country accessible to teachers of procuring the requisite information in Science to obtain certificates, and secondly, on the reward or inducements offered being such as to tempt them to try for them, such in fact as to create a real demand, when we may be sure a supply will follow. The experiment has been tried, and I think we may consider with great success.

In June 1859 the first Minute was passed; and the fact of there being the certificate allowances and examination for certificates in November was made known by it. No attempts were made to circulate this information very widely, and indeed it was not till very shortly before the first examination that the detailed syllabus of the subjects of examination could be published, and it was considered desirable not to press the matter forward, but to wait and take advantage of the experience afforded by the first examination. Nevertheless, in the following November (November 1859) 57 candidates came up. There were 104 entries for subdivisional certificates (there were then only 11 subdivisions of subjects); 43 candidates were successful and 65 subdivisional certificates taken,—14 first grade, 20 second grade, 32 third grade. This last year (1860) 89 candidates came up; there were then 13 subdivisions of subjects. And there were 170 entries for subdivisional certificates; 75 candidates were successful and 121 subdivisional certificates were taken,—22 first grade, 44 second grade, 55 third grade.

We see then that though the subject is not at all widely known in the country, there were a considerable number of candidates at the first examination, and an increase of nearly 60 per cent. at the next—in one year. There are now 106 teachers

certificated under the new system. Many of the candidates who came up to the last examination had come up to the previous one ; some had failed, others came up again to improve their certificates, clearly showing that there was sufficient inducement both to tempt them to work and qualify for, as well as to improve the grade of their certificates. A large proportion came up for the first time, some having as I know done a good deal towards working up their subjects since the first announcement. Judging from applications, I believe there are many now preparing themselves for next examination. It must be a work of time—of years—for any large number of persons who may be induced to turn their attention to it to qualify themselves. But the experience of these examinations shews that there is a sufficient inducement ; and the result of the first examination more especially shews that, what with training colleges and other institutions, there *is* a means, however limited, of obtaining scientific instruction without the creation of a special training school ; and that there are a number of persons who, by availing themselves of these means and by private study, have already qualified themselves for teaching, Science, and to whom it is only necessary to offer certain inducements to make them turn their attention in that direction.

As Science classes are more generally established and as the teaching of Science becomes more developed, the difficulty of obtaining the training for a teacher will naturally diminish greatly. At the same time much might be done to meet this want, if in large towns where the means exist, courses of evening lectures were given such as those which, at small fees and with this special aim, were found so successful by the Professors in the School of Mines in Jermyn-street last autumn ; and which, from being better known, will I have no doubt be even more appreciated when repeated this year.

But as I said before the success of the experiment of the last two years shews there is no absolute necessity for government to specially train Science teachers, and this being the case, it appears undesirable that they should do so. I do not mean to say that by this means more accomplished teachers might not be obtained, but besides the great expense, there is, at present, next to no occupation for them. A trained Science teacher would naturally expect to make his livelihood by Science teaching and by that alone. At present there is scarcely a place in England where he could do so, I mean where there would be full occupation for his time in teaching Science to the industrial classes.

According to the regulations at present in force a school or class must receive aid wholly from either one or other of the departments, not from both. The Science and Art Department cannot pay for elementary teaching, nor, on the other hand, are the teachers in elementary schools permitted to receive payments from the Science and Art Department for Science instruction given in elementary schools. Of course, in elementary schools wholly maintained by voluntary contribution, the teacher can give his more advanced boys instruction in Science, and if certificated in Science obtain his payments by so doing. I may mention instances of this in the Glasgow Secular School., and the Birkbeck School at Bethnal-green. But it is well known that the children of the working classes are taken from school, as a general rule, long before they can obtain any benefit from instruction in Science, in fact three fourths of them are scarcely left long enough to learn to read and write. We may hope that, as the advantages are better appreciated by the parents, Trade Schools such as that at Bristol will be established in different parts of the Kingdom, where the children of the working classes may be sent for a short time after they leave the elementary school. But at present the Science instruction must, from the circumstances of the case, be confined to evening classes at Mechanics' Institutions and such places for adults, and these principally during the long evenings of the winter months. The teacher of an elementary school under inspection who has not pupil teachers apprenticed to him may obtain Science payments by teaching an evening class of this description. And again, working mechanics, clerks in merchants' offices, and others, who have other occupations for the rest of his day, may from the grants of the Science and Art Department make an acceptable addition to their incomes. Such are the men who have taken the Science certificates, and have then, in many cases by their own energy, started Science classes. On their obtaining the assistance of a few gentlemen of the place, such as magistrates, clergymen, aldermen, and town-councillors, managers of schools, etc., to give them the necessary vouchers and to conduct the examination of the Department, all the conditions are fulfilled, and it rests with themselves and on their own energy and success in teaching to make much or little by their venture. But as I before stated there is not a sufficient field at present for the full employment of Science teachers as such alone.

To return to the examination of the Department which is held simultaneously all over the United Kingdom and superintended

by the local Committees. Last May the first of these general examinations was held at 35 different places in the following towns; some two or three towns having examinations at more than one centre:—Aberdeen, Accrington, Almondbury, Banbury, London (3), Birmingham, Bristol, Burnley, Calne, Clifford, Cork, Highgate, Glasgow (2), Gloucester, Halifax, Haslingden, Hollingwood, Lambeth, Manchester (2), Middlesbrough, Redruth, St. Agnes, St. Ives, St. Just, Salford, Slaithwaite, Painswick, and Wigan. Three of the examinations were for classes not taught by certificated teachers, for instance those of the Manchester Mechanics' Institution, while many pupils taught by uncertificated teachers came up to the other examinations. There was no difficulty found in obtaining the services of, and carrying out the examination by local agency. It is intended in future years not to have more than one centre for examination in the same town, or at least within a reasonable distance, the examination being conducted by an amalgamated committee or by corporate action. The examination papers prepared by the examiners in London were sent down so that those in each subject should arrive just in time for the examination in that subject, and the worked papers were returned by the Committee by the first post. There were examinations in all the subjects, and 1000 worked papers were sent up. Inorganic Chemistry apparently was the favourite subject for in it there were 405 papers. Physiology and Experimental Physics were the two next, there being 126 in the former, and 146 in the latter.

1000 papers do not represent 1000 candidates, because the same candidate in some cases came up in two and even in three subjects, but it represents 3000 or 4000, at least I should think under instruction, for there were very many under instruction who were not considered sufficiently prepared to come up for examination. 725 papers were *passed*, 310 being up to the standard for Queen's prizes; these were 59 first class, 100 second class, and 151 third class. Of the Medals, which are given competitively, 4 gold, 11 silver, and 16 bronze, were awarded; 3 gold, 3 silver, and 5 bronze, being unawarded in consequence of candidates not having in some subjects done sufficiently well to merit them. I may mention that some, and those of the most successful candidates, were women, medals and prizes having been obtained by them in Botany, Physiology, and Chemistry.

open to all, all can receive prizes, but it is only on pupils of the working classes, that the teacher receives payments. Hence these examinations should afford a great stimulus to what I may term the lower middle class education of the country, which at the present time is admitted to be extremely bad.

The Science and Art Department can thus stimulate scientific instruction in the country generally while at the same time it assists the industrial and poorer classes to obtain it, and that, not by forcing them all to adopt one approved plan, but allowing each place to adopt that which may suit it best. We find its aid comprehending plans so very dissimilar, as the Bristol Diocesan Trade School; the Glasgow Secular School; classes in Mechanics' Institutes, as at Manchester and Huddersfield; classes held as in the institutions in connection with East Lancashire and Cheshire Union of Mechanics' Institutes, and the Cornwall and Devon Miners' Associations, in different places but taught by the same teacher.

The system from having as its guiding principle payments on results, allows of government aid being given unaccompanied by the slightest interference to regulate the manner of the instruction; but paying only for good work however accomplished, while remaining simple in its administration, it is capable of the most diverse application.

1000 papers do not represent 1000 candidates, because the same candidate in some cases came up in two and even in three subjects, but it represents 3000 or 4000, at least I should think under instruction for there were very many under instruction who were not considered sufficiently prepared to come up for examination. 725 papers were taken, 310 being up to the standard for Queen's prizes; these were 50 first class, 100 second class, and 171 third class. Of the Medals, which are given competitively, 4 gold, 11 silver, and 16 bronze were awarded; 3 gold, 3 silver, and 5 bronze being unawarded in consequence of candidates not having in some subjects done sufficiently well to merit them. I may mention that some, and those of the most successful candidates, were women, medals and prizes having been obtained by them in Botany, Physiology, and Chemistry.

HPD

27.8.96

38041200133852